

# **Mapping in the 21<sup>st</sup> Century**

\* A Geospatial Information Revolution \*

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Throughout the 20th century, there have been major changes in our National Security Strategy and the military forces that support it. The threats have changed, warfighting strategies have evolved and equipment capabilities have increased with every leap in technology. Although the U.S. Army has relied on paper maps for mission planning, rehearsal, and execution, maps have remained relatively unchanged during this period. Traditional maps are about to undergo a revolutionary change. Namely, the National Imagery and Mapping Agency (NIMA) will make the transition from mapmaker to provider of geospatial information and support the Army's terrain visualization efforts.

Maps, two-dimensional representations of geospatial information, must fulfill several requirements. They must: provide a common view of the battlespace; be current, accurate and accessible; and support automated terrain analysis. The paper map has been an essential tool in the successful accomplishment of countless operations for decades. As the Army transitions to a digital force, the map as we know it has limitations that diminish its utility.

To achieve a common view of the battlespace, all personnel and systems involved in a given operation must have the same version of the map, chart, or set of geospatial data. Current mapping products use a variety of datums (earth reference coordinate systems) and sources and may not provide that common view.

Geospatial information from NIMA is not available worldwide. In fact, the military's entire requirement for Topographic Line Maps (TLM) - the technical name for the 1:50,000-scale map that NIMA has used for decades - covers about 22 percent of the earth's landmass. In addition, due to fiscal constraints, only the highest priority requirements of the commander in chief and service for geospatial information are satisfied. As a result, some recent operations have commenced without complete mapping coverage (for example, Grenada, Somalia and Desert Storm). Although NIMA and local topographic teams have been able to rapidly generate geospatial information in some form useful to warfighters, historic crisis-response processes will not provide early entry forces with an information edge. In the future, the need for information dominance with respect to terrain will necessitate a near-global database of geospatial information.

Under current processes, warfighters select their maps from a menu of standard NIMA products. Even if they have a requirement only for roads or rivers, they must wait for production

of a standard product. In effect, warfighters are held hostage to all of the requirements that the "standard" map must satisfy. They either get the whole map or no map.

Finally, paper maps do not have the requisite embedded information necessary to support automated decision processes. In the past, Army topographic units have relied on paper maps and digitized versions of them to create manually tactical decision aids such as cross-country mobility overlays. Generation of this type of product is extremely labor-intensive.

In 1995, the Defense Science Board, and later the Army Science Board, reviewed the Defense Mapping Agency's (DMA) potential for meeting its customer's needs. These reviews took into account the challenge of declining budgets, worldwide deployments, and DMA's mission to provide geospatial information. The boards recommended that the agency develop a new means to support the services with geospatial information.

DMA, and its successor organization, NIMA, have worked with the military services for the past two years to address the recommendations. They collectively developed a revolutionary approach to provide geospatial information to warfighters. This approach is referred to as the foundation data concept. It relies on a readiness and responsiveness strategy that moves away from many standard products toward an information management environment.

This strategy calls for establishment of near-global coverage of foundation data, which includes medium-resolution elevation, feature, and imagery and navigation data for an improved readiness posture.

The foundation data consists of several components. The elevation component, Digital Terrain Elevation Data, contains elevation data at 30-meter resolution. It provides elevation data nearly equivalent to the contour interval on a topographic line map. The foundation feature data provides information on transportation, vegetation, boundaries, surface drainage and populated areas. The digital point positioning database, the stereo imagery component, is a one-meter resolution data set that supports precision targeting and feature extraction. The monoscopic imagery component, controlled image base - 5 meter, is a five-meter resolution data set that supports battlefield visualization and feature identification. NIMA's Digital Nautical Chart supplies nautical information. The aeronautical component is derived from NIMA's digital vertical obstruction file and digital aeronautical and airfield information file.

Foundation data components can replace many standard NIMA data sets, by either using a single component or fusing components together to take advantage of the unique characteristics of each data set (for example, fusing imagery and feature data).

The responsiveness component of the Foundation data concept calls for generation of higher resolution elevation, feature, and imagery data called Mission Specific Data Sets (MSDS). If commanders determine that foundation data do not contain geospatial information of sufficient resolution for a planned operation, they can request higher resolution imagery, elevation and feature data. This request will either be satisfied in theater or passed to NIMA. NIMA will generate MSDS by supplementing pre-existing foundation data with the detailed information required to support specific mission requirements. The Foundation data concept will enable commanders to specify exactly what they want on maps. It makes the phrase "Standard NIMA products" obsolete.

The Foundation data concept supports the Army's terrain visualization efforts in several ways.

- It will provide a Common Operational Picture of the Battlespace. Foundation data and mission specific data are tied to the same earth reference system (i.e. World Geodetic System-84 datum). Thus, when one data set is overlaid on top of another, all features align.

For example, the imagery component can be draped over elevation data to provide a three-dimensional view of the battlespace. Although foundation feature data lacks the feature density of the 1:50,000 scale topographic line map, when combined with imagery and elevation data, the warfighter gets a comprehensive view of the battlespace.

- It supports automated decision making and analysis processes. Foundation feature data are attributed data. Thus, features will have embedded information such as road width, tree stem diameter and bridge length which facilitate automated decision-support functions such as automated route selection and cross-country mobility analysis.
- Foundation feature data and mission specific data will be tied to the same data structure. This network will allow data to be used for command, control, communications, computer, and intelligence systems; modeling and simulation; and hard-copy map production.
- The foundation data concept will improve production of current and timely digital geospatial information. This geospatial information can be updated more rapidly than traditional hard copy maps. In addition, mission specific data sets produced for one operation or command will be integrated into the database.

Numerous initiatives are underway to develop the requisite information necessary for the Foundation data concept to be realized. NIMA is initiating a multiyear program to build Foundation Data and is constantly looking for more cost-effective means to collect information (such as high-resolution elevation data and vegetation information) that historically has been very expensive to generate. In addition, NIMA and the Defense Information Services Agency are developing the joint mapping tool kit which will facilitate the display and manipulation of foundation data and mission specific data on the Army battle command system.

The concept of a warfighter-defined custom “digital map” is a major change from the way the Army has used maps in the past. A warfighter’s area of interest and required resolution of the data assist in defining mission specific data sets for imagery or elevation. The difficult part of defining such a set, however, is selecting the features. The current data structure supports many possible thematic layers (such as obstacles and vegetation) that contain over 200 features. The TRADOC Program Integration Office for Terrain Data, in conjunction with the Army’s Topographic Engineering Center and NIMA, has developed five packages of MSDS. These packages have varying levels of features and attributes from which planners can elements. NIMA produced both digital and hard-copy products of these packages for evaluation by the Army. Although these packages will not meet all users’ needs, they serve as a point of departure for operational forces when planning time is constrained.

The changes brought about by the transition from traditional mapping data to the digital geospatial information inherent to the foundation data concept are revolutionary. As with all such changes, the Army faces several challenges associated with implementing the Foundation data concept, including training the force, devising the means to request and manage MSDS and data dissemination. The future is encouraging because the Foundation data concept will enable warfighters to get the specific geospatial information that they need when they need it. It will also enable the warfighter to truly “see the terrain” and attain an information edge over any adversary.